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LAST OF FOURTEEN OPERATIONS IN THIR-
TEEN YEARS FOR TIC DOULOUREUX.

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FOR NERVOUS DISEASES, ETC.,

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[Read February 14, 1894.]

MEDICAL HISTORY BY DR. MITCHELL.

J. T. K., aged forty-one years; married; dental surgeon. Until his thirtieth year he was in excellent health, and had no indications of any tendency to neuralgic disease. The history was in every way a good one up to the beginning of the present trouble, with the exception that he was born after a labor prolonged for four days.

The patient was small but strongly built, though when first seen in a much reduced state physically, and in a condition of severe nervous and moral prostration. There is a marked difference in the color of the two eyes, the right one being brown and the left blue.

In 1880, without any previous warning, he had a sudden attack of violent pain in the right upper jaw, nearly limited to one tooth. This came on during a meal. The tooth was extracted, but the pain continued in the socket from which the tooth was withdrawn until this healed, when the pain began in another tooth, and the process was repeated until three were drawn. Only one of these, the twelve-year-old molar, which had been filled some years before with tin and amalgam, was found in an unhealthy condition. The roots were perfectly dry and the foramen very much enlarged. Some portions of the alveolar process, it is said, came away with the extraction of this tooth, and this was also dry and unhealthy-looking. The following summer a portion of bone of that alveolar margin was removed for necrosis. After the parts were healed the pain ceased, with the exception that occasionally at the side of the molar tooth a sharp pain, like that of an exposed nerve, was felt if the part were touched. This also disappeared during the following few months.

In February, 1881, while washing his face, the patient felt a pain shoot



through the infra-orbital region, which increased in severity from day to day until he had to stop work on account of it. After a great deal of suffering, his physician, Dr. Kirk, of Fox Chase, brought him to Dr. R. J. Levis, who after examination thought that the pain was caused by the gums contracting so as to press tightly upon the nerve radicles. This he attempted to remedy by cutting loose the gum from the bone for the whole depth of the process, both on the palatal and buccal sides; but no benefit was felt from the operation, and later Dr. Levis cut down upon the infra-orbital nerve at the foramen and removed a small portion of the nerve again, without succeeding in relieving the pain.

After suffering great agony for some weeks, Mr. K. was advised to have his upper teeth extracted. In the attempt to do this the eye-tooth was broken in the gum, and the root could not be removed until Dr. Garretson extracted it some time afterward, and in examining the mouth found a necrosis of a portion of the upper jaw, which he removed.

For a short time the pain in the face was much better, but became finally so very severe in the region of the infra-orbital again, that Dr. Garretson cut down upon the infra-orbital nerve and removed all the portion anterior to the foramen, finding the nerve intact. This was in September, 1881.

No further operation was done until February, 1883. Mr. K. matriculated in the Philadelphia Dental College in 1881, but on account of his sufferings was obliged to desist from work. In the spring of 1883 pain returned in a small area in the side of the upper jaw, and the sixth operation, undertaken by Dr. Garretson, removed a portion of the upper jaw, exposing the antrum. The patient had comparative ease until the fall of 1883, when the pain began again, and he was variously treated during the succeeding four or five years without much relief.

In the winter of 1887-88 he suffered dreadfully, and in March Dr. Garretson made a resection of the second division of the fifth nerve on the affected side, this being the seventh operation, but how much of the nerve was removed is not stated.

In March, 1889, the third division of the fifth nerve, back to the foramen ovale, was resected by the same surgeon, with much relief; but the pain soon returned, and the ninth operation was the ligation of the facial artery in 1890. In September of the same year, the tenth operation took place—an excision of the whole upper jaw. In September, 1891, Dr. Garretson did the eleventh operation, by opening, at the patient's request, the inferior dental canal and removing the nerve as far forward as the foramen.

From each of these frightful series of operations the patient experienced some temporary relief, with the exception of the one or two otherwise noted. On admission to the Orthopædic Hospital and Infirmary for Nervous Diseases, in May, 1893, he was suffering from three or four paroxysms of severe pain a day, for the relief of which he was taking half a grain of morphine twice a day, and more if the attack was too painful to bear. The right face was sunken, wasted, and seamed with the scars of the several operations; and, in spite of the removal or cutting of the various branches of the fifth nerve, the upper part of the face was still very sensitive, so that to twitch the right eyelid, or scratch the right eye, would cause a violent outburst of pain in the *lower jaw*, running forward to the corner of the mouth.

An area of diminished sensation was found upon the outside of the cheek extending from the lobe of the right ear throughout the distribution of the fifth nerve, under the right eye to the median line of the nose and to the median line of the lips. Sensation was not lost in this area, but much diminished, and heat and cold were perfectly distinguished throughout the region.

A few days after his admission a small corneal ulcer was observed upon the outer side of the right eye, midway between the pupillary margin of the iris and the periphery.

The first week in June, Dr. Weir Mitchell and Dr. Keen had a consultation and decided to examine the condition of the inferior dental nerve, in view of the possibility of its having regenerated so as to cause the pain which centred in the lower jaw. The severity and frequency of the paroxysms by this time had somewhat diminished from those which occurred on his admission to the hospital, but the smallest movement of the tongue against the cheek or lips would cause paroxysms; to open the mouth at all widely, to put a finger against the cheek, would all bring on furious pain. A small portion of the right cheek immediately below the eye was totally anæsthetic to touch, extending from near the middle line on the right of the nose down to and including the ala of the nose and out upon the cheek about one and one-half inches. The right angle of the mouth was capable of very little movement, and the lower eyelid was almost completely paralyzed.

The site of most severe suffering was not at this time at the mental foramen, but about an inch posterior to it. From this point the pain spread throughout the inferior dental distribution.

Removal of the Gasserian ganglion was proposed by Dr. Keen at this time, but as the patient preferred that a new attempt upon the inferior dental nerve should be tried first, Dr. Keen consented to this, and on June 10, 1893, operated.

SURGICAL HISTORY BY DR. KEEN.

An incision was made in the line of one of the old scars near the lower border of the lower jaw. The soft parts being lifted at the site of the mental foramen, a very minute opening was perceived to which the soft parts were adherent by a little thread which may have been a nerve but which tore with slight traction. About an inch and a quarter back of this supposed mental foramen was another quite large foramen corresponding to the focus of pain, from which came out what appeared to be a nerve, which spread out fan-like in the soft parts. This was excised and placed in Müller's fluid. Between the two foramina a button of bone was removed, but no canal and no nerve could be discovered. I then chiselled away the bone back to and under the large abnormal foramen just mentioned, and found the inferior dental nerve as a thick cord, and followed it backward to the inferior dental foramen. When I seized the nerve to extract it from its bed, although the patient was profoundly anæsthetized he struggled considerably. An inch and a quarter of the nerve was resected from the abnormal opening backward, the nerve being drawn down as far as possible. The upper opening was then closed by a sheet of sterilized gold-foil and the lower portion of the bone, where it had been trephined half through its substance and chiselled backward, was filled with dental cement made of oxide of zinc powder and glacial

phosphoric acid. The operation was characterized throughout by exceedingly troublesome hemorrhage, which Dr. K. tells me was characteristic of the former operations also. A dozen strands of silkworm-gut were laid in the wound for drainage, and the wound closed and dressed as usual. He made a prompt recovery. Neither the gold-foil nor the cement has given the slightest trouble.

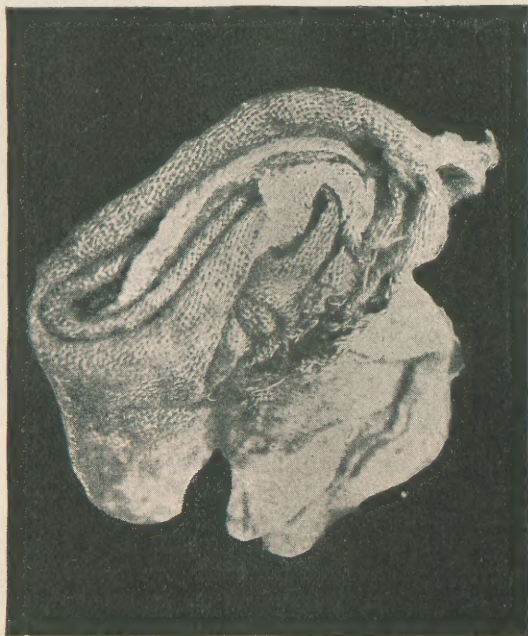
On the 24th of August he was readmitted, having suffered much pain again for a month. He describes the pain as being in the right cheek, coming on in paroxysms, induced by eating, talking, or any movement of the lips, teeth, or cheek. The slightest stroking of the cheek will bring it on. He has no pain if the parts can be kept absolutely immovable. The areas of paræsthesia on the right side of the nose and cheek seemed to be somewhat more sensitive, and this time the pain complained of is all above the level of the inferior maxillary. In the absence of Dr. Keen, Dr. Wm. J. Taylor operated again on the 28th of August, removing the tissues about the infra-orbital foramen, with only temporary relief. Early in September the pain had returned as violently as ever, and even large and frequent doses of morphine failed to relieve him. Accordingly he re-entered the Infirmary in October, with the intention of undergoing the removal of the Gasserian ganglion.

Operation, October 18, 1893, by Dr. Keen. One-thirtieth of a grain of strychnine and a quarter of a grain of morphine were given him just before beginning the etherization. An omega-shaped incision was made, the length of which, vertically, was three inches. One leg terminated immediately in front of the tragus, the other just in front of the junction of the anterior and middle thirds of the distance between the external auditory meatus and the external angular process. The temporal artery was cut, and this and a few other vessels required ligation. Dr. M. H. Cryer, with the new surgical engine of S. S. White & Co., and a circular saw one and a half inches with a guard, then rapidly and very successfully divided the external table, excepting at the two extremities. Here, fearing perforation before the inner table and the rest of the flap were divided, I determined to chisel through. I first chiselled the superior four-fifths of the flap, passing through the inner table with ease, and then chiselled the extremities. At the posterior terminus when I was only giving an ordinary light blow with the mallet, the chisel suddenly penetrated the skull to a depth of perhaps half an inch, and immediately a considerable hemorrhage showed me that the posterior branch of the middle meningeal had undoubtedly been cut. I then chiselled quickly through the anterior extremity, broke the bone and reflected the flap. Here again was an additional trouble, for the anterior branch went through a distinct canal at the anterior inferior angle of the parietal bone and of course was torn and bled freely as I turned down the flap of bone and scalp. A finger over each artery, however, almost controlled the hemorrhage, and in a very few moments I was able to place a pair of hæmostatic forceps on each. A cut was seen in the dura corresponding in length to the width of my chisel. A small, curved Hagedorn needle was then passed first around the anterior branch in the dura, then the posterior branch was caught. The opening in the dura was sutured by catgut. The middle lobe of the brain was then lifted with care and great gentleness from the bone, but this was followed by

hemorrhage which might well be called alarming. Lifting up the middle lobe with a spatula, I discovered that it was not, as I had feared, from the middle meningeal ruptured at the foramen spinosum, but that the blood came from the neighborhood of the ganglion. I could not think, with the gentleness I had used, that the cavernous sinus had been ruptured, but at all events it was too free, not only to allow of removal of the ganglion, but for the integrity of the man's life if it continued. The hemorrhage did not yield to hot water. I packed it twice with gauze which arrested it temporarily, but on removing the gauze it bled as freely as ever. Accordingly I packed in a considerable piece of iodoform gauze and closed the flap by six retention stitches, with the intention of removing the packing in two or three days and then removing the ganglion. Before packing, the dural wound was closed by a stitch of catgut.

During the operation he had received in all one-eighth of a grain of strychnine, and an hour after the operation was completed was in bed with warm extremities, a pulse of 80, temperature of 98°, but a respiration of only 8 in the minute, but very deep. His color was very fair.

FIG. 1.



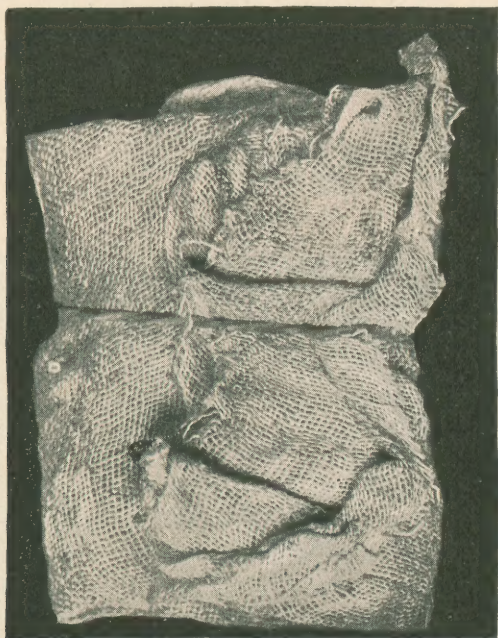
Shows the natural size of the piece of iodoform gauze (37 x 6 inches) packed in the cavity of the skin for three days without harm; seen edgewise.

October 20th. His eyes were examined by Dr. G. E. de Schweinitz, who reported as follows: "Irides unlike in color: right brown, and left blue. Pupils very small, right smaller; reaction normal. Scar in right cornea. Oval optic disk, paler than normal; veins full and larger than usual; arteries

normal. No swelling of disk and no spots in the eye-ground. A field roughly taken shows no limitations.

21st. (Third day.) Since the operation the patient has done well, excepting that he has had, of course, a number of paroxysms of pain. The only evidence of increased intra-cranial pressure due to the gauze has been a slowing of the respiration down to from 6 to 10, and a slight aphasic condition. The gauze was introduced on the right side of the head, and he is a right-handed man. The highest temperature was 100.8° F.

FIG. 2.

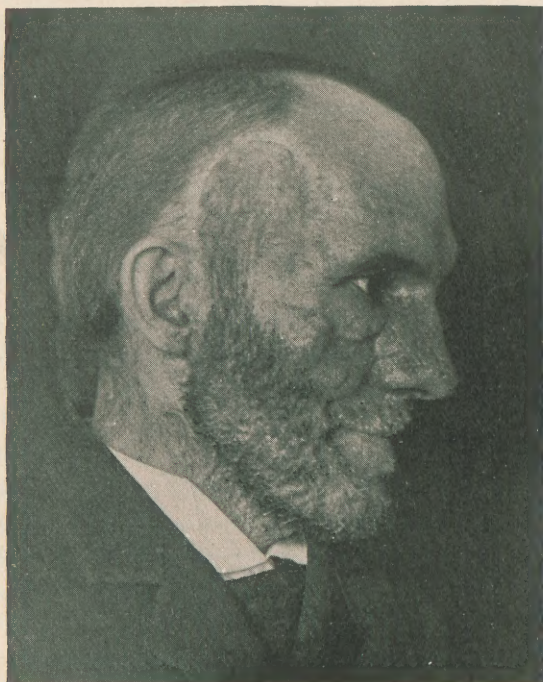


The same piece of gauze ; seen sidewise.

To-day I reopened the wound, which was partly united. The small cut in the dura, made by my chisel three days before, was entirely closed, and there was not the slightest evidence of any harm from it. I drew out the gauze very carefully, keeping a stream of hot water playing on it all the time so as to loosen it very thoroughly. I found on measurement that the piece was 37 by 6 inches. (Fig. 1.) It weighed $2\frac{1}{2}$ ounces, and a similar piece, dry, weighed $2\frac{1}{2}$ drachms, showing that it had absorbed $17\frac{1}{2}$ drachms of blood. (Fig. 2.) On withdrawing it I was very fearful at first that the hemorrhage, which was moderately profuse, would again prevent my doing anything to the ganglion, but on introducing some small hot sponges I was able to overcome the bleeding in the course of a little while by the heat and pressure. Evidently the hemorrhage did not come from the cavernous sinus, nor from the middle meningeal, both of which I found to be intact.

In a few moments I was able to expose the middle meningeal artery and the second and third divisions of the fifth nerve, and to see also the little flap of dura which covered the ganglion. I had great trouble in separating the third division from the middle meningeal, as they ran very close together. Moreover, both at the second and third divisions, the slightest touch of the blunt hook, Allis's dissector, scissors, knife, anything, produced the sudden escape of at least a drachm of blood, which obscured the field of operation.

FIG. 3.



The patient after recovery, showing scars of various operations.

Pressure by a small gauze sponge for a very few moments would cause the bleeding to cease, but the slightest manipulation produced its recurrence again. However, after cutting both of these nerves and tracing them back to the ganglion, I tore the little extra-dural sac open, and with the Allis dissector and a small sharp spoon I thoroughly destroyed the ganglion.

The wound was then closed and the usual dressings applied. The patient's condition both throughout the operation and at its end was decidedly better than at the operation on the 18th.

He made a complete and rapid operative recovery and was out of bed on the fourth day, the entire wound being healed. The highest temperature was 101.2°. The aphasia gradually bettered and finally disappeared. He complained bitterly of pain in the head at first, but this soon diminished,

especially after the roots of two teeth were kindly removed by Dr. Cryer. Soon after the operation, the morphine being stopped after the first five days, he had the most intense mental depression. In fact, this went to such a degree and assumed such delusional forms that I was doubtful whether it was due to possible cerebral changes from the three days' pressure of the gauze, or to the withdrawal of the morphine alone, and I seriously feared a permanent insanity. Bromides, strychnine, and sulphonal were all used in turn and in full doses, but none of them did him any good. Finally, codeine in $\frac{3}{4}$ -grain doses in the twenty-four hours gave him relief in sleep and checked his delusions, so that in a few days he was quite recovered, and since then until the present date, February 14, 1894, has been absolutely rational, free from delusions and pain, and without any desire for his morphine, which on the contrary he loathes after thirteen years of slavery to its use. His eyes were examined by Dr. de Schweinitz, and found to be in the same condition as on October 20th. Glasses were fitted which gave him excellent vision. (Fig. 3.)

His condition, from a neurological standpoint, will be stated by Dr. J. K. Mitchell.

REMARKS BY DR. KEEN.

First, as to the method of operating. Horsley's operation by a temporal flap, opening the dura and tearing the roots of the fifth nerve behind the ganglion from the pons, seems to be needlessly severe. As between the Hartley-Krause operation, which I adopted, and that of Mr. Rose,¹ through the base of the skull, I think there is no question that the easier operation is that devised by Dr. Hartley,² and soon afterward and independently by Krause.³ The table (*vide infra*) shows that thus far they are equally safe. There is much more room for the manipulations by this method than by Rose's, in which one to a great extent works in the dark, through a very small opening. Moreover, Tiffany⁴ has made the important observation that a deliberate opening of the dura, by allowing the escape of considerable cerebro-spinal fluid, gives much additional room for the intra-cranial manipulations. It will be noticed that the two ends of my incision were placed the one directly in front of the tragus and the other in front of the junction of the anterior and middle thirds of the distance between the external auditory meatus and the external angular process. By examining the skull I have found that this marks, as nearly as may be, the anterior limit of the middle fossa of the skull, and gives, therefore, the widest opening possible for access to the interior. It has the disadvantage that it

¹ British Med. Journ., 1892, i. 53.

³ Arch. f. klin. Chir., xliv. p. 821.

² Annals of Surgery, May, 1893, p. 571.

⁴ Annals of Surgery, February, 1894.

impinges upon the canal, if there be one, for the anterior meningeal; but anyone accustomed to controlling hemorrhage in the skull should certainly be able to cope with this difficulty, and if the artery, as is usual, does not run in the canal, no trouble will occur. The advantage of making the flap of scalp and bone, as was done by the osteoplastic resection of Wagner-Wolff, instead of trephining, is, I think, very great, the larger opening being an advantage of the first moment. Moreover, the two ends of the incision should be carried well down, almost to the level of the zygoma, so that the middle fossa will be opened almost completely down to its floor, otherwise the manipulations are much more difficult. The division of the skull by Dr. Cryer with the surgical engine was only moderately satisfactory as to speed. Since then I have had made, at the instance of Dr. E. T. Darby, a drill with two spiral threads which answers the purpose very much better on account of the rapidity with which it divides the bone. Dr. Cryer¹ has figured another drill for the engine, which he says will work more rapidly, but with which I have had no experience. The diagram seems to me to point toward a successful instrument.² In dividing the posterior portion of the bone, it will be noticed that my chisel, by a blow which was not deemed to be too severe, penetrated the skull and severed not only the dura, penetrating the cavity of the brain to some extent, but also, what might have been a serious complication and was for a time an embarrassing one, divided the posterior branch of the middle meningeal. This accident has cautioned me as to the use of the chisel. Instead, I should have used Hartley's or some similar osteotome, which, being conical throughout instead of with parallel sides as the chisel had beyond the bevelled edge, would have prevented this accident.

Unfortunately, also, I had to deal with a "bleeder," as was proved by the prior operations, and I presume this was the reason why the hemorrhage was so profuse on the gentle lifting of the temporo-sphenoidal lobe in the middle fossa. No one with ordinary prudence would attempt to remove the Gasserian ganglion while the field was filled with blood, as fatal injury might be done to the carotid or to the cavernous sinus which lie in such immediate proximity to the ganglion. I think the introduction of the gauze, following the suggestion and practice of Krause in his first operations

¹ Medical News, January, 1894.

² In a later case at the Jefferson Hospital, Dr. Cryer kindly used this drill for me, and with great advantage.

of this sort, was the wisest step I could have taken. The hemorrhage three days later, when I removed the gauze, was comparatively profuse, but the operation was successfully completed. I was very much surprised, however, when I withdrew the gauze to find that I had packed in so large a piece. It covered 222 square inches, and formed a large wad, which, as it will be observed, had absorbed two ounces and a drachm and a half of blood. It has puzzled me a good deal to account for the absence of symptoms other than the slowing of the respiration and the slight aphasia, as a result of such a large foreign body within the cranium. Possibly a little might be accounted for by the slight yielding of the flap; possibly more by the slight escape of cerebro-spinal fluid by my puncture of the dura; but allowing for all this, the foreign body was a very large one, which must have produced a great deal of pressure. I certainly never introduced so large a piece before, and the fact that four days after it was removed the patient was out of bed with the wound practically healed, showed how rapid was the recovery. That gauze can be left for a long time within the cavity is well-known, and has recently been excellently illustrated in a case reported by Dr. Chalmers Da Costa, in which a piece of gauze 8 by 1 inches was retained for thirteen days within the cavity of the skull.

Second, the results of removing the ganglion are, of course, not yet absolutely determined. The first case was operated on by Mr. Rose in 1891.¹ Since then I have been able to collect 40 cases operated on by the two methods, and the result thus far is as follows: Of the 40 cases, 6 have died and 34 recovered. In none of them has there been any return thus far reported, excepting a partial return in one of the earlier cases of Mr. Rose. In no other case than his first one has there been the loss of an eye, and neither Dr. Tiffany in the 4 cases he has reported, nor I, took the least precaution for the protection of the eye, by preliminary temporary suturing of the lids. The results thus far seem to encourage us very much. If the removal of the ganglion should in time prove to be a final cure in cases of tic douloureux, my own opinion would be that it should be the *first* operation recommended for severe cases, provided that time and experience enable us to diminish the present relatively large mortality. If, however, the pain should return in any considerable proportion of the cases, then, as this is the final and terminal operation, I would certainly advise my patients hereafter to have repeated

¹ British Medical Journal, 1892, i. 261.

peripheral operations done, gradually approaching the centre and the removal of the ganglion, should the pain return again and again, should be the *last* operation. In other words, if the operation of removal of the ganglion proves to be an unqualified success and its dangers are lessened, we should begin with that and not waste time with peripheral operations. If it is only, like the peripheral operations, a temporary relief, then we should begin at the periphery and work toward the ganglion by as slow steps as it is possible to take.

I append a table of all the operations I have been able to collect up to the present time.

TABLE OF OPERATIONS FOR REMOVAL OF GASSERIAN GANGLION.

Author.	Reference.	Recovered.	Died.	Total.
Rose ¹ . . .	British Medical Journal, 1892, i. 261	5	..	5
Rose ¹ . . .	Lancet, 1892, ii. 953	1	1	2
D'Antona ¹ . . .	British Medical Journal, 1893, i. 81	1	...	1
Park ¹ . . .	Trans. Amer. Surg. Assoc., 1893, vol. xi. 238	2	...	2
Andrews, ¹ . . .	Journ. Amer. Med. Assoc., Feb. 18, 1893, 180	3	1	4
Krause ² . . .	Annals of Surgery, Sept., 1893, 362	5	...	5
Roberts ² . . .	Proc. Philadelphia Co. Med. Soc., 1892, 490	1	...	1
Lanphear ¹ . . .	Pacific Medical Journal, 1892, xxxv. 647	1	...	1
Hartley ² . . .	Annals of Surgery, May, 1893, 511	1	..	1
Doyen ¹ . . .	Rev. de Chir., 1893, 391	1	...	1
Horsley ³ . . .	British Medical Journal, 1891, ii. 1191	...	1	1
McBurney ² . . .	Annals of Surgery, 1893, i. 516, 519	2	...	2
Parkhill ¹ . . .	Medical News, Sept. 16, 1893, 319	1	...	1
Edw. Kerr ¹ . . .	Journ. Amer. Med. Assoc., Feb. 18, 1893, 181	1	...	1
Fernandez ⁴ . . .	Siglio Med., Madrid, 1892, 804, 819; 1893, 4, 18, 36	...	1	1
Fowler ² . . .	Personal communication	1	1	2
Tiffany ² . . .	Annals of Surgery, Jan., 1894, 47	4	...	4
Finney ² . . .	Johns Hopkins Bulletin, Oct., 1893	2	1	3
Novaro ¹ . . .	Journ. de Méd., Chir. et Pharm., Bruxelles, Sept. 20, 1891	1	...	1
Keen and Mitchell, ²	The present case	1	...	1
		34	6	40

REMARKS BY DR. MITCHELL.

After the final operation on October 18th, it was not until the latter part of December, just before his discharge from the hospital, that the patient's mental condition improved so much that a careful examination of the areas of sensation could be made. There was no absolute anæsthesia, except between the margins of the flap of this operation. Sensation to touch was everywhere else preserved in some slight degree. Pain sense was but slightly impaired as compared with the condition previous to the operation. He had no

	Cases.	Recovered.	Died.	Mortality per cent.
¹ Rose's method	19	17	2	10.5
² Hartley's method	19	17	2	10.5
³ Horsley's method	1	0	1	100.0
⁴ Method unknown. Reference furnished me by Dr. Hinsdale, which could not be verified.				

spontaneous pain in any part after the operation, and at the time of his discharge the aphasia had entirely disappeared as well as the mental depression.

In the regions supplied by the supra-orbital nerve, sensibility to touch was diminished as far as the vertex upward and forward to the median line of the face from the lobe of the ear and the lower border of the inferior maxilla. The mucous membrane of the lips and cheek on the right side, and the right side of the tongue were also partially anæsthetic. On the right side the sense of taste was entirely lost. The ocular and palpebral conjunctivæ were insensible to touch, but in the right infra-orbital region immediately about the scar of the operation upon the infra-orbital nerve, there was a small area which was hyperæsthetic.

When last seen, during the last week in December, I found that an area as large as a half-dollar, with its centre upon the outer third of the right eyebrow, covered a space which was hyperæsthetic to touch though not to pain, and this although he was unable to move voluntarily the muscles above the brow on this side.

Dr. K. has since returned to the hospital, reporting himself as continuing without any pain in the face, but one statement which he makes is certainly curious. During the cold weather when he goes out he says that he feels as if he had two faces, one quite apart from the other; one of which, the left or normal side, felt the cold and the other did not.

When violent neuralgia marks out with lines of fire the course of superficial nerves, or when by operation we demonstrate the ramification of the tiny twigs to the skin and surface tissues, it is rather the rule than the exception to find some small anomaly in the distribution of the ultimate fibres, as compared with the topography described in the books. Physiological methods of tracing and mapping these nerves are needed, rather than those of the anatomist's dissecting-table. In the case here described, the only anatomical peculiarity was the situation of a foramen more than an inch posterior to the mental foramen, giving exit to a nerve of some size, distributed thence on the tissues of the cheek. The foramen mentale was exceedingly small, and through it passed only a little twig, so slender as to make its discovery difficult and its recognition doubtful.

In another patient of mine upon whom Dr. Keen operated some years ago, a different difficulty was experienced in locating this opening. The patient, an elderly woman, had had all her teeth removed. The gums and probably the alveolar processes had conse-

quently atrophied, and the foramen was thus brought much nearer to the upper margin of the jaw than usual, and some search was needed before it could be found.

The regeneration that we so commonly find occurs in divided nerves when we do not want regeneration, followed the several nerve sections here, as in other cases. Such a frightful amount of pain teaches an opportune lesson of the desirability of deeper operations in the early course of trigeminal neuralgia. If the neuralgia persists, a neuritis almost inevitably follows, whether brought about by the same irritation which sets up the neuralgia, or, as I cannot but think often happens, set up *by* the neuralgia, the constant pain keeping the nerve over-stimulated and over-full of blood until it passes from active congestion into inflammation. A neuritis, however small, is a bad neighbor. We speak of ascending and of migratory neuritis; but every neuritis ascends and generally descends too, though it may be only a small spread in either direction. But spread it will—and it is certainly astonishing when we consider the close connection between the nerves of the face and the great centres of life in the brain, that we so rarely see brain disease result from this form of nerve-inflammation.

At the origin of these cases some form of peripheral irritation is often to be found, but by no means constantly. The teeth are usually blamed, and one seldom sees an old case in which they have not been more or less completely removed—because, if they have not caused pain, they might cause pain. The seat of distress is often in a tooth, but do we not always find the sensation of pain referred to the periphery of the affected nerve? I have seen at least one case in which relief of pain that had persisted in spite of palliative operation, resulted from the application of a properly fitting denture. No doubt the restoration of a natural amount of pressure upon the gums and alveoli had something to do with this. In Dr. K.'s case the original cause was in a tooth and destructive processes in the alveolus.

Besides the pain which accompanies these neuralgias, various other troubles may result from the peripheral irritation. One of my patients had had one or two attacks of lesser epilepsy a month, always at her menstrual periods, up to her fiftieth year, when they ceased with the menopause. When, several years later, she began to have the trigeminal neuralgia, they returned, and became much more frequent, coinciding with the sharper paroxysms of pain. They disappeared with Dr. Keen's resection of the offending nerve, and have never recurred.

The second and third divisions of the trifacial nerve are much oftener subject to the attacks of tic than the first. It is impossible to assign any reasons other than suppositions for this. The functional necessities of the face and eye require that the nerves which supply them shall be sensitive and acutely perceptive in the highest degree. This gives them a certain susceptibility. Then the position, especially of the second and third divisions, exposes them peculiarly to sources of external hurt, such as irritation, or even infection, from decayed teeth, injury from cold, or from substances taken into the mouth, acting through the lingual branch as well as through the dental filaments.

The ganglion removed has not yet been minutely studied. It certainly would seem reasonable to expect to find in the centre, after over-stimulation continued for so long a period of years, some signs of this excess of action in the nerve cells.

Hodge, in the admirable papers published in 1889 and 1891, upon exhaustion of nerve centres, has pointed out the microscopic changes we may expect to find in tired and exhausted cells. They are so distinct that when once acquaintance has been made with them it is not difficult to say of two specimens, "This one came from an animal exhausted by muscular action; this one came from an animal in a healthy, unfatigued condition."

It has been supposed by some authors that the root of the malady lay in an atrophy of the ganglion; but were atrophy to be found, I should rather incline to regard it as a result than as the cause of the morbid condition of the nerve.

